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Pathology of Tick Bite Lesions in Naturally Infested Skin and Hides of Ruminants: A Review

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Abstract: Ticks are relatively large acarines, which are blood sucking ectoparasites of vertebrates. There are two families that are Argasidae and Ixodidae, but the veterinary importance is Ixodidae (Hard tick) that cause damage to the skin and hides of ruminants. Generally, the predominant gross pathologic lesions were crusts and scabs, which mostly occurred because of either degeneration or traumatization as a consequence of earlier primary lesions. Histopathologically various epidermal reactions, ranging from hyperkeratosis, prakeratosis, lichenified stratum corneum and acanthosis, characterized many of skin and hide damage. The dermal condition was mostly inflammatory resulting in dermal fibers sometimes becoming disoriented. The leathers were generally hard, unsightly and fibrosed with many tunnellings. The grain surface was coarse, rough and holes pierced through several affected areas. The different disease downgraded leather quality in various manners and marred their aesthetic appearance.

Key words: Histopathology · Leather surface · Ixodidae

INTRODUCTION

Ticks are obligate, blood feeding ectoparasites of vertebrates, particularly mammals [1]. Two families, Ixodidae and Argasidae are commonly known ticks. Ixodidae is the most important family and it is often called the hard ticks [2]. The ticks pierce the skin of its host with its chelicerae and insert the barbed hypostome to secure it to the host initially [3].

The ticks feed by attaching to the skin of animals to suck their blood via needle like mouthparts (hypostome). Most of pathogenic ticks, affecting skin and hides of domestic ruminants belong to the family Ixodidae (hard ticks). Tick bites directly damage to the skin at the site of attachment. Adverse reactions to ticks depend in part on content of salivary secretions. The severity of local cutaneous reactions varies not only with salivary secretions, but also with host resistance [4].

When a tick feed, a wound is created in the skin. This is usually a sterile abscess and will heal to form a small scar. The inflammatory and hypersensitive reactions at feeding site are irritating and painful. Ticks in large numbers on the back and flanks of cattle make many small scars in the skin, so that when the skin is processed for leather, blemishes appear that reduce the value of the leather [5, 6].

Attachment to most causes irritation of the skin, with subsequent ulceration and some time secondary bacterial infections. In addition, tick wound becomes infested by screwworms of other agents of myiasis [7].

Like other ticks the ixodiadae, are temporarily parasites and spend relatively short periods on the host. The number of host to which they attach during their parasitic life cycle varies from one to three and based on this, they are classified as one host ticks where the entire parasitic development from larvae to adult takes place on the one host *(Rhipicephalus annulatus),* two host ticks larvae and nymph in one host, but the adult on the other (*Hyalomma marginatum*) and three host ticks where each stage of development takes place on different hosts (Amblyomma) [2].

Tick bites can be directly debilitating to domestic animals, causing mechanical damage, irritation, inflammation and hypersensitivity. Various types of tick worldwide feed on cattle and cause dermatitis. Apart from species of genera *Argas* and *Otobius*, only

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the hard ticks have veterinary importance [1]. Histopathologically, various epidermal reactions, ranging from hyperkeratosis, parakeratosis and lichenified stratum corneum and acanthosis, characterized many of the skin disease [8]. Though hide and skins are important source of income, its contribution to the national economy may be for below the expected potential. This is because the quality of hides and skin has deteriorated due to pre-slaughter defect [9]. Therefore, the objectives of paper are:-

- To highlight the tick species responsible for the lesions on the hide and skins of ruminants.
- To review gross and histopathological findings of tick bite lesions on the skin and hides of ruminants.
- To indicate the significance of tick bite lesion for hide and skin production.

Important Species of Ticks Responsible for Skin and Hide Damage

Amblyoma: Amblyomas are large, usually ornate, ticks whose legs have a band of color eyes and festoons are present. The palps and hypostome are long and ventral plates are absent in males. The bite by this genus being particularly painful, probably due to long mouth parts [2].

Amblyoma americanum, is so called because of a single white spot on the scutum of the female the engorged female is up to 10 mm in length, bean shaped, the female is reddish brown in color, becoming light grey when engorged. On the scutum are two deep parallel cervical grooves and large, pale spot at its posterior margin. The male are only 2-3 mm in length and because of the small idiosoma the four pair of legs is readily visible. In both sexes, coxa I have a long external spur and a short internal spur and the mouth parts are much longer than the basis capitulum [10].

Boophilus: In ornate ticks which eyes present and festoons absent. The palps and hypostome are short. These, often known as "blue ticks" are one host tick [2]. *Boophilus microplus* has short, straight gnathosoma. The legs are pale cream. The body is oval to rectangular and the scutum is oval and wider at the front. The anal groove is obsolete in the female and is faint in the male and surrounds the anus posteriorly. Coxa I is bifid. The spiracle are circular as oval. The nymphs of this species have an orange brown scutum the body is oval and wider at the front. The body color is brown to blue grey, with white at the front and sides [10].

Rhipicephalus: The genus is composed of about 60 species, all of which were originally endemic to the old world and for the most part, distributed throughout sub-Saharan Africa. However, many species have now been introduced into a range of new habitats worldwide. They act as a vector of a number of disease pathogens (*Babesia*, Tularemia *and Rickettesia*). They infest a variety of mammals. Most species are three host but some Species of genus are two host ticks [10]. *Rhipicephalus* are easily recognized by the hexagonal shape of the basis capituli when viewed dorsally [11]. The male have anal plates and accessory shields. This parasite includes both three host and two host ticks. Species: *R. appendiculatus* [2].

Dermacenter: This is one of most important genera metastriate ticks. The basis capituli appears rectangular when viewed dorsally directed spurs occur on the first pair of coxae. The palp is short and thick. The scutum is almost always ornamented [11]. Ticks of *Dermacenter* are medium sized to large ticks. Festoons and eyes are present. The coxa of the first legs is divided into two sections in both sexes. Coxae progressively increase in the size from I to IV. The male lack ventral plates and in the adult male, the coxae of the fourth pair of legs is greatly enlarged. Most species of dermacenter are three host ticks. But a few are one host ticks [10].

Hyalomma: They are characterized by their elongated palps, which are at least twice as long as wide. The distinct eyes are located in sockets adjacent to the postero-lateral edges of scutum. *Hyalomma* ticks are unornamented. Most species live in xeric environments where they parasitize small and medium sized wild mammals and livestock species [11]. The male have ventral plates on each sides of the anus. *Hyalomma* species are usually two host ticks, though some species may use three hosts. They are most commonly found on the legs, udder, tails or perianal region. Species*: H. anatolicum* [10].

Tick Bites: At the site of tick bite focal dermal necrosis and haemorrhage occur, followed by an inflammatory response, often involving eosinophils, although a hypersensitivity reaction may be involved in the local response, the innate inflammatory response and dermal necrosis is sufficient to damage the hide and skin. Tick bite wound can be infected with *Staphylococcus*

bacteria, causing local cutaneous abscesses or pyaemia. Heavy tick infestation can result in significant blood loss, reduced productivity, reduced weight gain and can cause restlessness [1].

The pathogenic effects are associated with the feeding mechanism of the parasite, which is ideal for both penetrating the skin and transmitting microorganisms. In the feeding process a thrusting motion of the hypostome through lacerated skin and the looking effect of its curved teeth follow the scissor like action of the digits at the end of the chelicerae on the tissues. The salivary gland is through to produce a hyaluronidase like substance to assist in penetration, cement like material which assists locking and anticoagulant. The dorsal groove in the hypostome provides a channel for the saliva to flow into the host and subsequently, blood and lymph into the tick [12].

Damage on the sheep skin is primarily found along the belly area as where the fleece is thinner. Lamb skin is particularly susceptible to skin damage. Secondary bacterial infection of bite increases the severity of the damage. Skin injuries can attract blow flies and screw worm flies that deposit eggs on the wound and produce marks that look like hole, pinpricks on the grain or scars that mostly occur in the belly [13]. The mouthpart of ticks is structurally similar to those of mites. The gnathosoma carries a pair of four segmented palps, which are simple sensory organs, which help the tick to locate its host. The fourth segment of each palp is reduced and may articulate from ventral side of the third, forming a pincer like structure. Between the palps lies a pair of heavily sclerotized, two segmented appendages called chelicerae, housed in cheliceral sheath. At the end of each chelicera is a rigid, somewhat triangular, plate bearing a number of sclerotized teeth like digits are used to cut and pierce that skin of the host animal during feeding [14].

Gross lesions: Most tick bites are painless; in fact, victims are often unaware that they have been bitten. The initial findings are red papule at the site of the bite. This might progress to an extremely purities, local swellings followed by the formation vesicles and echymosis, necrosis and ulceration might occur. Most bites heal within 3 weeks. However, a persistent nodule (tick granuloma) might last for month's reaction to tick bites likely result from injected toxins, local irritation, or hypersensitivity. Immunologic reactivity such as delayed, type IV hypersensitivity and combs reaction will lead to in duration and nodular formation [15].

The cutaneous sign associated with tick feeding in cattle include pustules and alopecia. The tick mouth part penetrates the epidermis and become lodged in the dermis where hemorrhage, collagen generation and wedge shaped lesions [1]. Tick causes crust and scab (Matted coat) sometimes showing bare skin [15].

Histopathological Findings: Histological change associated with tick infestation include, collagen degeneration, eosinophilic folliculitis and furuncles, pustule formation, granulomas, lymphocyte mural folliculitis and eosinophilic rich dermal infiltrate [16]. The microscopic pathological change were hyperkeratosis, edematous epidermal strata denoted by widening of intracellular spaces with loss of cellular contacts, total degeneration and necrosis of epidermal cells from underlining basal laminae, collagen fibrillar destruction with spatial disorientation in the grain and dislodgement of collagen boundless by excessive cellular infiltrate within the corium [8].

Myiasis: Myiasis is the infestation of organism and tissue by fly larvae that feed on necrotic as living tissue of host. It can be classified as facultative and obligatory. Larval stages move over the wound surface ingesting secretion, exudates, dead cells and debris but not live tissue. However, they induce irritation, insure cells and provoke exudation [10]. Facultative myiasis caused by *Musca* species; *Calliphora* species; *Phaenilia* species; *Lucilia* species; *Phormia* species; and *Sarcophaga* species. The fly of obligatory myiasis is dependent on fresh wound, as the site of larval development. This larva can liquefy and devour viable tissues, there by enlarging the wounds [1].

Myiasis is most frequent in late spring, easily summer and early fall, which correlates with the increased proliferation of flies. Blow fly myiasis is especially a problem in sheep in most area of the world. The predisposing factor for myiasis:" accidental as surgical wounds, rainy weather and virtually any dermatosis causing exudation and associated with bacterial infection. Therefore, common site for myiasis are wounds, from shearing, dehorning, castration, docking, fighting, wire cuts, ear markings and branding; the navel of new boon animals, cancer eye in cattle. Sever pinkeye in cattle and tick bite lesions [10].

The third instar larvae of warble flies, hypoderma species, produce painful nodules lesions approximately 3 cm in diameter with central hole in the skin of the

back. Infestation is seen most usually in young animals. If accidentally ruptured or the larva dies within the skin, anaphylaxis and death may occur. Hide and skin damage is the main economic effect of warbles. If larvae become lodged within the spinal cord, acute posterior paralysis without systemic signs may occur. Flying adults of *Hypoderma bovis* cause annoyance and fright with running in loss of production [1] two types of cutaneous myiasis can be distinguished; primary, in which the fly larvae feed primarily on necrotic tissues and only secondly invade an injured tissue. Clearly, primary myiasis is most significant to animal health and therefore the most costly, not only in terms of mortality, morbidity and reduced productivity, but in cost of control [17].

Significance for Skin and Hides Production: Ticks are directly or indirectly involved in causing substantial financial losses to the livestock industry of Ethiopia account 75% of the animal export, a conservative estimate of 1 million birr loss annually was made through reject and down grading of hide and skin in Ethiopia [18].

Tick bite may damage host at the site of attachment causing local injury, which may predispose to secondary bacterial infestation. The lesion caused during feeding may predispose to myiasis also at slaughter the value of hide and skin may be reduced [10]. A huge amount of foreign exchange earning was estimated to be lost from the MESACO global tanner due to various skin defects. A total of 1,282,472.01 ETB (Ethiopia Birr) lost was recorded within four months in 2009 from this tannery.

In 1906 economic loss due to *B. annulatus* in the USA was estimated at 130 million dollars per annum which in 1976 terms would have been of the order of a billion dollars. Even when *B. annulatus* and *microplus* had been eradicated, tick losses in the cattle and sheep industries were estimated to be 65 million dollars in 1965. In Australia the cost to cattle industry of tick control in 1975 was estimated at 40 million dollars, of which one third was the cost of control and two third was the loss in production. Heavy tick infestation damage hides, skin and cause a loss in live weight gain which has been estimated at 0.6 g per day for every engorged female *B. microplus* and 4-5g per day female *A. variegatum* [3].

Hide and skins accounts for 12-16% of the total value of exports in Ethiopia. More than 60 spp. of ticks infesting both domestic and wild animals have been recorded in Ethiopia. Among these about 37 spp. and sub spp. are very wide spread and important parasites of livestock. The economic impact of tick infestations is enormous worldwide. In 1984, the United Nations food and agricultural organization (FAO) estimated the global cost of Ixodidae tick infestations to be $ 7.0 billion annually [18].

Control and Treatment: The control of Ixodidae tick is largely based on the use of chemical acaricides applied either by total immersion in a dipping both on in the form of a spray, shower or spot on. Where severely parasitized animals require individuals' treatment, special formulation of acaricides suspended in a greasy base may be applied to affected areas [2]. The long term control of three host ticks is geared to the period required for the adult female stages to become fully engorged, which has residual effect of say 3 days, it will be at least 7 days before any fully engorged female reapers following treatment during the tick season should therefore kill the adult female ticks before they are engorged, except in case of very sever challenge when the treatment interval has to be reduced to 4 or 5 days [10].

Acaricides are pesticides used to kill ticks. Acaricides include chlorinated hydrocarbons (e.g. Dichlordiphenyl trichloroethane; DDT), organophosphorus compounds (Diazinon), carbamates (Carbaryl), pyrethroid (e.g. Permethrin, flumethrin), formamidines and avermectins. The pyrethroides are among the safest and most effective pesticides and are now widely used for tick control [11].

One of the simplest methods used to recover ticks form pasture is to drug a blanket over the ground to which unfed ticks become attached as they would be a host [12]. The development by ticks of resistance to most of the available acaricides posses such as a threat to livestock production in the tropics that alternative methods of control are urgently being sought, especially against two host and three host ticks which spend long periods of the host. Traditional methods, such as a burning of pastures are still used and are generally practiced during a dry period before rains, when ticks are inactive. This technique is still a most useful one in extensive range conditions and it is used after seeding of the grasses has taken place, regeneration of pasture will rapidly occur following the onset of rains [2].

Crude made from extract of semi engorged adult female *B. microplus* give effective immunity. Antibody destroys cells lining the tick is gut and allow blood to escape into the hemocele, some ticks die and the fertility of those remaining is reduced by up to 70%. The fertility of male is also reduced. A recombinant vaccine based on membrane bound glycoprotein Bm86 has been isolated and shown to be effective against acaricidal resistant

ticks. Its major effect is a progressive control in tick numbers in successive generations through a decrease in their reproductive capacity. Because the vaccine act as against an antigen in the ticks gut to which cattle one never exposed, they must be given booster injections at regular interval [17].

CONCLUSIONS

Tick bites cause damage or lesions on the hide and skin of ruminants. Therefore, the ruminants infested with tick results inflammation of the skin and hide, indirectly inflecting self wounding. Histopathologically the damaged skin and hide are shown to be granuloma, collagen degeneration, eosinophilic folliculitis, pustule formation, dermal infiltrate and grossly the skin and hide of ruminants have been made a crust and scab at the site of tick bite. This in turn affects the economy of the country.

Thus, based on the above conclusion the following recommendations are forwarded:

- Pathological findings and the extent of damage on the skin and hides due to ticks should be studied further.
- Control and prevention of tick infestations should get consideration to avoid loss of skin and hides due ticked leather and downgrading of quality.
- Awareness should be created for the animal owner about the damage of skin and hide due to ticks and possible prevention and control measure.

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